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United States
Department of
Agriculture

Soil
Conservation
Service

Bozeman,
Montana

CLARK FORK OF THE COLUMBIA RIVER

Natural Resource and Physical Features Inventory

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January 1983

INTRODUCTION

The Clark Fork of the Columbia River winds its way through the mountains of western Montana providing water for agriculture, industry, hydropower, recreation, fish, and wildlife. Because it serves so many purposes, the river is vital to the economy of western Montana. Its good health is important to all Montanans.

In 1981 the Deer Lodge Valley, Granite County, Missoula County, and Mineral County Conservation Districts requested the U.S. Soil Conservation Service, in cooperation with the Montana Department of Fish, Wildlife and Parks and U.S. Fish and Wildlife Service, to conduct a natural resource and physical features inventory of the Clark Fork River.

The conservation districts wanted baseline resource information about the river as well as management recommendations for landowners within the stream corridor. The districts also thought the inventory would help them administer the Natural Streambed and Land Preservation Law (SB-310) and be a springboard for informing the general public about stream corridor management.

SETTING

The Clark Fork was inventoried for 182.5 river miles from its beginning at the confluence of Silver Bow and Warm Springs Creeks to a point west of Alberton, Montana, before the river enters Cyr Canyon.

The river was divided into six reaches because of morphological and historical management differences. The reaches and their associated drainage areas are listed in Table 1.

Surrounded by rugged mountains covered by coniferous forest, the Clark Fork River valley is used for agriculture, transportation systems, and population centers. This combination of land uses throughout the Clark Fork watershed has caused many impacts to the river system.

Milltown Dam is on the Clark Fork River in the inventoried section. It is located just downstream from the confluence of the Clark Fork with the Blackfoot River. Milltown Dam is a hydroelectric dam owned by the Montana Power Company.

Riparian vegetation of the river corridor consists of an overstory of mixed stands of cottonwood[1], Douglas-fir, and ponderosa pine. The understory includes water birch, willow, rose, redosier dogwood, russet buffaloberry, Russian-olive, chokecherry, grasses, and forbs.

Wildlife inhabiting the stream corridor includes white-tailed deer, ruffed grouse, pheasant, mink, muskrat, raptors (birds of prey), and a variety of small mammals, songbirds, and waterfowl. Among the game fishes of the Clark Fork River are mountain whitefish and a variety of trout--rainbow, cutthroat, brook, brown, and bull. Largemouth bass, northern pike, and pumpkinseeds are found in isolated areas along the lower river. Longnose and largescale suckers, peamouth, chub, northern squawfish, and redside shiner also are found in the river.

Climate within the inventory area varies significantly with elevation. Frost-free period ranges from 90 days at Deer Lodge to 100 days at Missoula. The average annual precipitation is 11 inches in Deer Lodge and 13 inches in Missoula.

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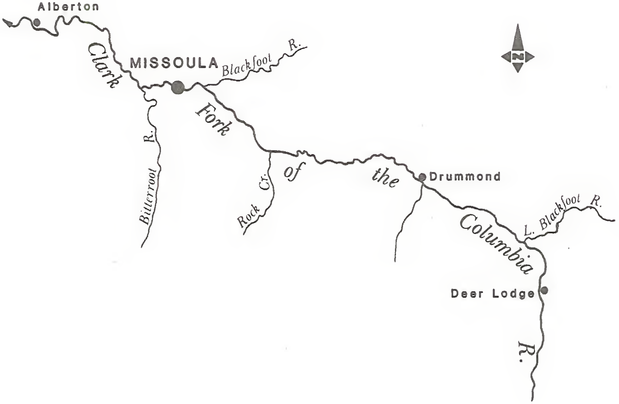
[1] Common and scientific names for plants and animals mentioned in this report are given in Appendix A.

FIGURE 1

CLARK FORK OF THE COLUMBIA RIVER LOCATION MAP

MONTANA



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SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

TABLE 1

Total Drainage Area to These Points

Reach	To	Drainage Area (sq. mi.)
I	Silver Bow and Warm Springs Creeks to Little Blackfoot River	1,160
II	Flint Creek	1,888
III	Rock Creek	2,612
IV	Blackfoot River	3,700
V	Bitterroot River	6,159
VI	To point approximately 5 miles downstream from Alberton, MT	9,523
	Clark Fork at St. Regis	10,709

The U.S. Geological Survey maintains six streamflow gauges on the Clark Fork River within the boundaries of this stream inventory. Data concerning maximum, minimum, average, and survey flows are presented in Table 2.

The Montana Department of Fish, Wildlife and Parks and the U.S. Fish and Wildlife Service 1980 Montana Stream Evaluation Map rates the Clark Fork within the surveyed area as a Class II and Class III stream. Most of the surveyed river has a Class II rating; only the area between Bearmouth and the confluence of Rock Creek is rated Class III. Class II and III streams are considered to have a high priority and substantial fishery resource, respectively.

Water quality of the Clark Fork River varies greatly according to Montana water quality standards of the Water Quality Bureau, Department of Health and Environmental Sciences. Water quality is classified as C-2 from Warm Springs Creek to Cottonwood Creek (near Deer Lodge), C-1 from Cottonwood Creek to the Little Blackfoot River, and B-1 for the remainder of its length in Montana.

Waters classified B-1 are suitable for drinking, culinary, and food processing purposes after conventional treatment; bathing, swimming, and recreation; growth and propagation of salmonid fishes and associated aquatic wildlife, waterfowl, and furbearers; and agricultural and industrial water supply.

C-1 waters are not suitable for drinking, culinary, and food processing purposes after conventional treatment, while C-2 waters are marginal for propagation of salmonid fishes and associated aquatic life.

The Clark Fork River is a meandering stream with a gradient of 0.20 percent (0.20-foot drop in elevation per 100 feet of stream length). Total channel length inventoried

is 963,345 feet (182.5 miles), and the total streambank length (left and right banks) is 1,926,690 feet (364.9 miles).

METHODS AND PROCEDURES

The author, Thomas J. Ganser, area biologist, U.S. Soil Conservation Service; Donald L. Tennant, fish and wildlife biologist, U.S. Fish and Wildlife Service; and James E. Vashro and Donald J. Peters, fisheries biologists for the Montana Department of Fish, Wildlife and Parks conducted the inventory during the summer of 1981. From a canoe and jet boat, the team recorded physical features of the river on aerial photographs of the stream corridor. The large-scale (1" = 250') photographs were taken April 15, 1981.

Team members recorded the following physical features on aerial photos during the inventory:

1. Visible man-caused channel alterations
2. Streambank alterations
    a. rock riprap
    b. jetties
    c. car bodies
    d. river gravel
    e. other
3. Eroding banks
4. Bank mass wasting
5. Composition of streambank vegetation
    a. herbaceous
    b. woody (trees and shrubs)
    c. tame pasture and cropland
6. Pools and riffles
7. Irrigation diversions
8. Debris jam

Pools and riffles were identified by flow and depth of water. Pools are characterized by deep, quiet water. Riffles are shallow, fast-moving water where the surface is turbulent and broken. Runs are moderately moving water, and the surface is not turbulent to the extent of being broken. Runs are intermediate between pools and riffles and are a major component of the term "pool" as used in this inventory.

Aerial photographs, field sheets, and symbol legends for this inventory are filed at three Soil Conservation Service field offices. The Deer Lodge office has material for Deer Lodge and Powell Counties; the Philipsburg office has material for Granite County; and the Missoula office maintains materials for Missoula and Mineral Counties.

FINDINGS

In the 182.5 miles of river inventoried, the Clark Fork undergoes many physical changes. Stream order is a term used to characterize the branching of a drainage. A first order stream is any unbranched tributary. A second order stream is formed when two unbranched first order streams join. A second order stream continues until it meets another second order stream to become a third order stream or enters a third order or higher stream as a side drainage. This process continues until the stream enters the ocean.

When the Clark Fork River begins, it is a second order stream changing to a third order with the confluence of

the Little Blackfoot River and to a fourth order stream with the entrance of the Blackfoot River just east of Missoula. It then continues as a fourth order stream through the remainder of the inventoried section.

Average stream gradient in reach I is 0.15 percent. It increases to 0.28, 0.22, and 0.31 percent through reaches II, III, and IV, respectively. Then it drops to an average gradient of 0.17 and 0.10 percent through reaches V and VI.

The Clark Fork displays a meandering stream character for the majority of the inventoried section. There are small sections where islands have developed as the river braided or formed multiple channels. Braiding typically occurs in aggrading reaches where bank materials are readily eroded, and a large debris and bed load exists.

Ninety-six percent of the Clark Fork's channel is classed as stable. Three percent is judged moderately stable and one percent unstable. Streambank stability is another story. Seventy percent of the streambanks are classed as slightly unstable, 22 percent as moderately unstable, and eight percent as severely unstable.

Stream channel alteration occurs in three of the six reaches. Construction of Interstate 90 and two railroads in reaches II, III, and IV caused most of the alterations. A large quantity of blanket rock riprap was used in channel alteration work.

Reaches II and IV have pool/riffle ratios of 0.6 to 1 and 0.5 to 1. Reaches I, III, and V have pool/riffle ratios of approximately 1 to 1. Reach VI has a pool/riffle ratio of 2.3 to 1, which indicates the relative size of relative size of the Clark Fork River at this point.

Reaches I and II have the highest percentage of bank mass wasting, with 10.3 to 10.8 percent, respectively. Mass wasting in other reaches ranges from 8.5 percent to a low of 3.8 percent in reach V. The highest incidence of eroding banks occurs in reaches II and III, with 5.7 and 5.8 percent, respectively. Other reaches range from 3.7 percent to a low of 1.4 percent in reach V.

Complete inventory data for the Clark Fork River by reach are presented in Tables 3, 4, and 5.

CONCLUSIONS AND RECOMMENDATIONS

Management efforts in the Clark Fork River corridor should be directed toward maximizing long-term channel and streambank stability. Efforts to stabilize critical areas will require both structural and vegetative treatments. However, the large size of much of the Clark Fork River makes structural treatment too costly to be a viable alternative for correcting the problems of individual landowners. For this reason, landowners' highest priority should be management of riparian areas to maintain and increase the stability of streambanks.

The inventory shows a disproportionately high amount of mass wasting of banks in relation to the amount of eroding banks. This may be due to the extremely high flows that occurred in the spring of 1981, shortly before inventory work began. Some of these banks may stabilize themselves within three to five years without assistance from man. Streambanks with an existing shrub community in good condition will likely stabilize more quickly.

The team developed seven recommendations for managing the Clark Fork River corridor:

1. Refrain from any further channel alteration work.

2. Where critical eroding banks exist, stabilize with blanket rock riprap and/or vegetative plantings. Do so in consultation with experienced resource conservationists, engineers, fishery biologists, and appropriate conservation district officials.

3. Where riparian zones will be grazed, management plans should be developed that recognize the value riparian vegetation has in providing streambank stability and fish and wildlife habitat.

4. Livestock watering sites should be developed away from the river for livestock safety and streambank protection. Where this is not possible, specific livestock watering sites should be developed along the river to replace free access to entire stream reaches.

5. Where natural streambank vegetation has been removed or destroyed, it should be replaced with a combination of native woody and herbaceous plant materials wherever possible.

6. Some log jams may need to be removed to prevent damage to streambanks. This decision should be made on a case-by-case basis. If removal is desirable, it should be done in such a manner that equipment does not enter the stream.

7. Temporary diversions made of rock and river gravel should be replaced with permanent irrigation diversions. Where practical, drop structures should be incorporated into these diversions to assist in stabilizing stream gradient.

In conclusion, the Clark Fork is a magnificent river system. As a resource, its economic and environmental attributes are inseparable. For this reason, proper management of the corridor is vital to Montanans and the people of the Pacific Northwest. Establishment of a sound management program for the Clark Fork River corridor will require the concerted effort of landowners, interest groups, and city, county, state, and federal units of government.

Because of the dynamic nature of river systems, inventories should be updated periodically. The purpose should be to determine further needs and to recognize accomplishments.

CLARK FORK RIVER STREAMFLOW SUMMARIZATION

TABLE 2

Gauging Station At or Near (Date of Installation)	Maximum Discharge (cfs)	Date	Minimum Discharge (cfs)	Date	Average Discharge (cfs)	Years of Record	Date(s) of Survey Near This Gauging Station	Discharge On Survey Date (cfs)
Deer Lodge (October 1978)	1,710	5/26/80	68	8/8/79	----	2	7/6 and 7/81	6 - 352 7 - 378
Gold Creek (October 1977)	5,640	5/25/80	108	9/10&11/79	----	3	7/7 and 8/81	7 - 697 8 - 689
Drummond *(March 1967)	8,490	6/20/75	58	9/15&20/75	843	8	7/8 and 9/81	8 - 919 9 - 866
Clinton (June 1979)	6,410	5/26/80	200	8/10/79	-----	1	7/9 and 10/81	9 - 954 10 - 891
Above Missoula (March 1929)	32,300	6/21/75	115	10/25/43	3,025	51	8/10/81	10 - 1,560
Below Missoula (October 1929)	52,800	5/23/48	388	1/18/33	5,499	51	8/12/81 9/17/81	2,180 1,670

*Sporadic readings until October 1972 when daily readings began

CLARK FORK RIVER INVENTORY DATA

TABLE 3

PHYSICAL FEATURES

	to Little Blackfoot REACH I	to Flint Ck REACH II	to Rock Creek REACH III
Length, ft. (mi.)	256,610 (48.6)	159,370 (30.2)	197,095 (37.3)
Gradient, % (ft./mi.)	0.15 (8.1)	0.28 (14.6)	0.22 (11.4)
Channel alterations, ft. (%)	0 (0)	10,360 (6.5)	24,275 (12.3)
Streambank alterations:			
Rock riprap, ft. (%)	2,300 (0.5)	27,730 (8.7)	87,650 (22.2)
Jetties, number	0	4	7
Car bodies, number	5	3	3
Car bodies as riprap, ft. (%)	0 (0)	0 (0)	170 (0.04)
Other, ft. (no.) [%]	1,220 [0.2]	8,730 [2.7]	(1)
Eroding banks, ft.			
Left bank	4,485	9,445	10,930
Right bank	5,480	9,605	11,920
Both banks (%)	9,965 (1.9)	19,050 (5.7)	22,850 (5.8)
Bank Mass Wasting, ft.			
Left bank	21,585	21,030	15,350
Right bank	31,080	13,300	9,320
Both banks (%)	52,665 (10.3)	34,330 (10.8)	24,670 (6.3)
Streambank vegetation, ft. (%)			
Herbaceous	13,930 (2.7)	24,145 (7.6)	28,950 (7.3)
Woody	459,175 (89.5)	280,855 (88.1)	335,480 (85.1)
Tame pasture or cropland	40,115 (7.8)	13,740 (4.3)	29,760 (7.6)
Sinuosity	2 to 1	1.5 to 1	1.3 to 1
Pools and Riffles			
Pool length, ft.	133,860	58,385	95,100
Riffle length, ft.	122,750	100,985	101,995
Pool/riffle ratio	1.1/1	0.6/1	0.9/1
Irrigation diversions, number	8	8	7
Debris jams, number	0	11	4

CLARK FORK RIVER INVENTORY DATA

TABLE 4

PHYSICAL FEATURES

	to Blackfoot R. REACH IV	to Bitterroot R. REACH V	to 5 mi past Alberton REACH VI
Length, ft. (mi)	87,815 (16.6)	74,520 (14.1)	187,935 (35.6)
Gradient, % (ft./mi.)	0.31 (16.3)	0.17 (9)	0.10 (5.5)
Channel alterations, ft. (%)	11,835 (13.5)	0 (0)	0 (0)
Streambank alterations:			
Rock riprap, ft. (%)	30,995 (17.7)	15,045 (10.1)	46,180 (12.3)
Jetties, number	5	6	5
Car bodies, number	1	7	1
Car bodies as riprap, ft. (%)	0	0	0
Other, ft. (no.) [%]	0	1,100 (0.7)	0
Eroding banks, ft.			
Left bank	2,150	1,770	5,985
Right bank	4,380	350	4,120
Both banks (%)	6,530 (3.7)	2,120 (1.4)	10,105 (2.7)
Bank Mass Wasting, ft.			
Left Bank	2,820	2,565	8,385
Right bank	5,800	3,125	23,435
Both banks (%)	8,620 (4.9)	5,690 (3.8)	31,820 (8.5)
Streambank vegetation, ft. (%)			
Herbaceous	8,580 (4.9)	4,775 (3.2)	23,895 (6.4)
Woody	154,885 (88.2)	140,795 (94.5)	333,910 (88.8)
Tame pasture or cropland	12,165 (6.9)	3,470 (2.3)	18,065 (4.8)
Sinuosity	1.1 to 1	1.5 to 1	1.1 to 1
Pools and Riffles			
Pool length, ft.	29,080	39,115	130,960
Riffle length, ft.	58,735	35,405	56,975
Pool/riffle ratio	0.5/1	1.1/1	2
Irrigation diversions, number	3	5	4
Debris jams, number	10	2	0

CLARK FORK RIVER INVENTORY DATA

TABLE 5

PHYSICAL FEATURES

	TOTAL	PERCENTAGE OF TOTAL	
Length, ft. (mi.)	963,345 (182.5)		
Gradient, % (ft./mi.)	0.2 (10.3)		
Channel alterations, ft.	46,470	4.8	
Streambank alterations			
Rock riprap, ft.	209,900	10.9)	
Jetties, number	27	)	11.5%
Car bodies, number	20	)	streambank
Car bodies as riprap, ft.	170	0)	altered
Other, ft. (no.)	11,050 (1)	0.6)	
Eroding banks, ft.			
Left bank	34,765		
Right bank	35,855		
Both banks (%)	70,620	3.7	
Bank mass wasting, ft.			
Left bank	71,735		
Right bank	86,060		
Both banks (%)	157,795	8.2	
Streambank vegetation, ft.			
Herbaceous	104,275	5.4	
Woody	1,705,100	88.5	
Tame pasture or cropland	117,315	6.1	
Sinuosity	1.5 to 1		
Pools and Riffles			
Pool length, ft.	486,500		
Riffle length, ft.	476,845		
Pool/riffle ratio	1 to 1		
Irrigation diversions, number	35		
Debris jams, number	27		

APPENDIX A

COMMON AND SCIENTIFIC NAMES

PLANTS

Cottonwood	*Populus spp.*
Douglas-fir	*Pseudotsuga menziesii*
Ponderosa pine	*Pinus ponderosa*
Willow	*Salix spp.*
Redosier dogwood	*Cornus stolonifera*
Water birch	*Betula occidentalis*
Russet buffaloberry	*Shepherdia cenadensis*
Rose	*Rosa spp.*
Chokecherry	*Prunus virginiana*
Russian olive	*Elaeagnus augustifolia*

MAMMALS

White-tailed deer	*Odocoileus virginianus*
Mink	*Mustela vison*
Muskrat	*Ondatra zibethica*

BIRDS

Ruffed grouse	*Bonasa umbellus*
Pheasants	*Phasianus colchicus*

FISHES

Rainbow trout	*Salmo gairdneri*
Brook trout	*Salvelinus fontinalis*
Brown trout	*Salmo trutta*
Cutthroat trout	*Salmo clarki*
Bull trout	*Salvelinus confluentus*
Mountain whitefish	*Prosopium williamsoni*
Longnose sucker	*Catostomus catostomus*
Largescale sucker	*Catostomus macrocheilus*
Peamouth chub	*Mylocheilus canrinus*
Northern squawfish	*Ptychocheilus oregonensis*
Redside shiner	*Richardsonius balteatus*
Largemouth bass	*Micropterus salmoides*
Northern pike	*Esox lucius*
Pumpkinseeds	*Lepomis gibbosus*